CHANGE

U. S. Department of Transportation
Federal Aviation Administration

8260.38A CHG 1

8/14/97

SUBJ: **CIVIL UTILIZATION OF GLOBAL POSITIONING SYSTEM (GPS)**

1. PURPOSE. This change provides criteria for the intermediate approach segment to be used for establishing GPS nonprecision approach procedures.

2. DISTRIBUTION. This change is distributed in Washington Headquarters to the director level of the Air Traffic Service; the Offices of Airport Safety and Standards, and Communications, Navigation, and Surveillance Systems; to the division level in the Flight Standards Service; to the National Flight Procedures Office; and the Regulatory Standards and Compliance Division at the Mike Monroney Aeronautical Center; and to the regional Flight Standards divisions. Distribution was changed to exclude those offices which no longer exist or do not have a need for the order.

3. EXPLANATION OF CHANGES. This change amends the criteria for the intermediate and final area. The new criteria provides for special construction of the intermediate waypoint (IWP) to also serve as an initial approach waypoint (IAWP). Criteria now allows the specialist to design the area when turn anticipation application is not desired. Criteria also provides turn expansion at the final approach waypoint allowing for turns in excess of 15°, up to 30°.

4. DISPOSITION OF TRANSMITTAL. After filing, this change transmittal should be retained.

PAGE CONTROL CHART

REMOVE PAGES	DATED	INSERT PAGES	DATED
1	4/5/95	1	8/14/97
2	4/5/95	2	8/14/97
7	4/5/95	7	8/14/97
8	4/5/95	8	8/14/97
		8-1	8/14/97
		8-2	8/14/97
9	4/5/95	9	8/14/97

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PAGE CONTROL CHART (Continued)

REMOVE PAGES	DATED	INSERT PAGES	DATED
10	4/5/95	10	8/14/97
APPENDIX 1		APPENDIX 1	
		6-1	8/14/97
		6-2	8/14/97
		6-3 (and 6-4)	8/14/97
		10-1 (and 10-2)	8/14/97
25	4/5/95	25	4/5/95
26	4/5/95	26	8/14/97
		27 (and 28)	8/14/97

/S/

Richard O. Gordon,
Acting Deputy Director,
Flight Standards Service

ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8260.38A

4/5/95
(Page revised 8/14/97 by CHG 1)

SUBJ: **CIVIL UTILIZATION OF GLOBAL POSITIONING SYSTEM (GPS)**

1. PURPOSE. This order provides criteria to be used in conjunction with Order 8260.3B, U.S. Standard for Terminal Instrument Procedures (TERPS), for establishing GPS nonprecision approach procedures. The guidance and criteria prescribed in this order are for nonprecision approaches. These criteria are in agreement with the result of data collected from tests conducted by the FAA and the joint tests by the FAA with the U.S. Air Force. These criteria provide for development of en route and nonprecision instrument procedures.

2. DISTRIBUTION. This change is distributed in Washington Headquarters to the director level of the Air Traffic Service; the Offices of Airport Safety and Standards, and Communications, Navigation, and Surveillance Systems; to the division level in the Flight Standards Service; to the National Flight Procedures Office; and the Regulatory Standards and Compliance Division at the Mike Monroney Aeronautical Center; and to the regional Flight Standards divisions. Distribution was changed to exclude those offices which no longer exist or do not have a need for the order.

3. CANCELLATION. Order 8260.38, Civil Utilization of Global Positioning System (GPS), dated 12/14/93, is canceled.

SECTION 1. GENERAL CRITERIA

4. GENERAL. This order applies to instrument procedures based on GPS airborne equipment meeting the en route, terminal, and nonprecision approach requirements of TSO-C129, Airborne Supplemental Navigation Equipment Using the GPS. Criteria for multi-sensor equipment utilizing GPS not meeting TSO-C129 requirements are contained in Order 8260.3B, chapter 15.

5. TERMINOLOGY. The following terms are defined, as referenced in this order:

a. Alongtrack Distance (ATD) Fix. The ATD fix is an alongtrack position defined as a distance in nautical miles (NM), with reference to the next waypoint.

b. Alongtrack (ATRK) Fix Displacement Tolerance. Fix displacement tolerance along the flight track.

c. Automatic Turn Anticipation. The capability of GPS airborne equipment to determine the point along a course, prior to a turn waypoint, where a turn should be initiated to provide a smooth path to intercept the succeeding course, and enunciate the information to the pilot.

d. Crosstrack (XTRK) Fix Displacement Tolerance. Fix displacement tolerance to the right or left of the designed flight track.

e. Instrument Approach Waypoints. Geographical positions, specified in latitude/-longitude used in defining GPS instrument approach procedures, including the feeder waypoint (FWP), the initial approach waypoint (IAWP), the intermediate waypoint (IWP), the final approach waypoint (FAWP), the missed approach waypoint (MAWP), missed approach turn waypoint (MATWP), and the missed approach holding waypoint (MAHWP).

f. MAWP. A waypoint used to designate the missed approach point (MAP) and used for construction of the final approach area.

* g. Reference Line. A line at the end of the fix error box of the FAWP prior to turn. *

h. Reference Waypoint. A waypoint of known origin used to compute the location of another waypoint.

i. Waypoint (WP). A predetermined geographical position defined by latitude/-longitude used for defining routes, terminal segments, and progress reporting purposes.

j. Waypoint Displacement Area. The rectangular area formed around and centered on the plotted position of a waypoint. This describes the region within which the aircraft could be placed when attempting to fly over the waypoint considering all system error components. Its dimensions are plus-and-minus the appropriate alongtrack and crosstrack fix displacement tolerance values found in table 1 (see appendix 1).

6. PROCEDURE CONSTRUCTION. GPS procedural construction requirements are as follows:

a. Waypoints. A WP shall be used to identify the point at which GPS navigation begins and the point at which GPS navigation ends for the procedure. WP's shall also be established along GPS routes where the route changes course; at holding fixes; at other points of operational benefit, such as route junction points for clarity; at the final approach fix (FAF); and, at the MAP. Each WP shall be defined by latitude and longitude in degrees, minutes, and seconds developed to the nearest hundredth of a second.

1 On the outside of the turn, the primary and secondary area tapers connect abeam the plotted position of the IWP to the primary or secondary arcs, respectively. The radii of these arcs are 2 NM and 3 NM, respectively, centered at the IWP.

2 On the inside of the turn, the tapers connect to the 2 NM and 1 NM points, respectively, abeam the plotted position of the IWP.

3 Turn anticipation (TA):

(aa) Determine the TA area as described in paragraph 10.

(bb) Note in figure 5 that, due to the width of the initial segment and the splay techniques mentioned in paragraph 10, special evaluations techniques are needed. The TA splay extends and connects to the final segment. Therefore, some obstacles are associated with the intermediate segment and some with the final segment. Also, the triangular area is formed, i.e.; G,H,A.

(cc) Evaluate the area enclosed by lines connecting points A,L,J,E,F,G,A, as intermediate segment primary.

(dd) Evaluate the area enclosed by lines connecting points L,D,E,E',J,J',L, as final segment primary.

(ee) Evaluate the area enclosed by lines connecting points A,B,B',L,A, as intermediate segment secondary.

(ff) Evaluate the area enclosed by lines connecting points B',C,D,L,B', as final segment secondary. Figure 5 contains blow ups of the referenced areas for clarity of detail.

(3) Obstacle Clearance. Refer to Order 8260.3B, paragraph 232c.

(4) Descent Gradient. Refer to Order 8260.3B, paragraph 232d and 288a.

* 12. INTERMEDIATE SEGMENT. Design the intermediate segment to begin at the IWP, or an ATD fix, and end at the FAWP.

a. Alignment. Align the intermediate segment with the final approach course. When this is not practical, the course change at the FAWP should not exceed 15§. Turns in excess of 15°, up to 30§, require turn expansion outlined in paragraph 13e.

b. Area. See appendix 1, figure 6.

(1) Length. The minimum length is 5 NM, the maximum length is 15 NM. Apply Order 8260.3B, chapter 2, table 3, to determine minimum segment length when the course change at the IWP exceeds 90§.

(2) Width.

(a) Primary area. Construct the primary area 2 NM each side of the centerline from the earliest point of the IWP to a point 4 NM prior to the FAWP. Taper from this point to 1 NM each side of the centerline at the plotted position of the FAWP. Apply terminal turn area expansion, as required.

(b) Secondary area. Construct the secondary area boundary 1 NM from the primary area.

(c) If the IWP is also an IAWP, or if a procedural construction advantage can be achieved and the distance between the IWP and FAWP is:

1 More than 8.5 NM, construct the primary area 4 NM each side of the centerline from the earliest point to the latest point of the IWP displacement area. At this point, taper inward at 30§ to a width of 2 NM each side of the centerline. Continue this width until a point 4 NM from the FAWP. Taper from this point to 1 NM each side of the centerline at the plotted position of the FAWP. Construct the secondary area 2 NM from the primary area boundary from the earliest point to the latest point of the IWP displacement area. Taper from this point to a width of 1 NM abeam the point the primary area reaches a width of 2 NM. Continue at the 1 NM width to a point abeam the plotted position of the FAWP. See appendix 1, figure 6a.

2 8.5 NM or less, construct the primary area 4 NM each side of the centerline from the earliest point to the latest point of the IWP displacement area. At that point, taper inward to 1 NM each side of the centerline abeam the plotted position of the FAWP. Construct the secondary area boundary 2 NM from the edge of the primary area beginning at the earliest point to the latest point the IWP can be received. Then from that point, taper inward to 1 NM each side of the primary area abeam the plotted position of the FAWP. See appendix 1, figure 6B.

(d) Terminal turning area expansion, paragraph 10, is not required when applying conditions 1 or 2 above. See appendix 1, figure 6c. *

c. Obstacle Clearance. A minimum of 500 feet of obstacle clearance shall be provided in the primary area of the intermediate approach segment. In the secondary area, 500 feet of obstacle clearance shall be provided at the inner edge, tapering to zero feet at the outer edge.

d. Descent Gradient. The optimum descent gradient in this segment is 150 feet per mile. The maximum descent gradient is 300 feet per mile.

* e. Descent Angles. Establish descent angles in accordance with Order 8260.3B, paragraph 252. *

13. FINAL APPROACH SEGMENT. The final approach segment begins at the FAWP and ends at the MAWP. Where stepdown fixes are established, they shall be defined as ATD fixes. See paragraph 6f.

a. Alignment.

(1) Straight-in. For a straight-in approach, the alignment shall not exceed 15° from the runway centerline (RCL) extended. Optimum alignment is coincident with the RCL. Where the alignment is 3° or less from the RCL, the optimum alignment is to the runway threshold. Where the alignment exceeds 3° from the RCL, the optimum alignment is to a point 3,000 feet from runway threshold on the RCL. Where operationally required, optional alignment is authorized to a point between, and including, the runway threshold and a point 3,000 feet prior to the runway threshold on the RCL, provided alignment is within 15° of the RCL. See appendix 1, figure 7.

(a) Except where the alignment is to the runway threshold, the mandatory location of the MAWP is at the intersection of the final approach course and the RCL.

(b) Where the alignment is to the runway threshold, the optimum location of the MAWP is at the threshold, with optional location of the MAWP anywhere along the final approach course between the FAWP and the threshold.

(2) Circling Alignment. The optimum final approach course alignment is to the center of the landing area, but may be to any portion of the usable landing surface. The optional location of the MAWP is anywhere along the final approach course between the FAWP and the point abeam the nearest usable landing surface. See appendix 1, figure 8.

b. Area. The area (straight-in and circling) considered for obstacle clearance starts at the earliest point of the FAWP displacement area and ends at the latest point of the MAWP displacement area, the runway threshold, or a point abeam the runway threshold, whichever is encountered last. See appendix 1, figures 9 and 10. The area extended to threshold beyond the MAWP, when required, has a constant width for both primary and secondary areas and those lateral dimensions equal the lateral dimensions at the MAWP. See appendix 1, figure 10.

(1) Length. The length of the final approach segment is measured from the plotted position of the FAWP to the runway threshold or a point abeam the threshold. The optimum length is 5 NM. The maximum length is 10 NM. The minimum length shall provide adequate distance for an aircraft to meet the required descent and to regain course alignment when a turn is required over the FAWP. Use table 2 (see appendix 1) to determine the minimum length of the final approach segment. A segment exceeding 6 miles in length should incorporate a stepdown fix, provided a decrease of at least 60 feet in the MDA or a reduction to visibility minimums can be achieved.

(2) Width.

(a) The final approach primary area is centered on the final approach. It is 1 NM wide on each side of the course at the earliest point of the FAWP displacement area. This width remains constant until the latest point of the FAWP displacement area. It then tapers to the width of the XTRK displacement tolerance at the latest point of the MAWP displacement area. See table 1 for fix displacement tolerance values.

(b) A secondary area is 1 NM wide at the FAWP paralleling the primary area each side of the displacement area, then tapers to a width of 1/2 NM each side of the primary area at the latest point of the MAWP displacement area.

c. Obstacle Clearance.

(1) Straight-in. The minimum ROC in the primary area is 250 feet. In the secondary area 250 feet of obstacle clearance shall be provided at the inner edge, tapering uniformly to zero feet at the outer edge.

(2) Circling. A minimum of 300 feet of ROC shall be provided in the circling approach area. Order 8260.3B, paragraph 260, applies.

d. Descent Gradient. The optimum descent gradient is 300 feet per mile. Where a higher gradient is necessary, the maximum permissible descent gradient is 400 feet per mile.

* e. FAWP Turn Expansion Construction. See appendix 1, figure 10a.

(1) Inside Turn Expansion. Apply the criteria in paragraphs 10a, b, c, d, e, and f.

(2) Outside Turn Expansion.

(a) Construct radii to outside turn areas of primary and secondary areas.

1 Primary area radius, R1: Apply the approach category of aircraft turn radius, as prescribed in appendix 1, table 3.

2 Apply secondary area radius, R2, as prescribed in appendix 1, table 1.

(b) Scribe R1 from point A, made up of the outside edge of primary area at end of intermediate segment, abeam the FAWP prior to turn, and mark point B on the reference line.

(c) Draw an arc, R1, from point A, using point B as its center. Connect this arc to the final segment primary area boundary with a connecting line 30§ relative to the final approach course tangent to the arc. This area is now part of the final segment primary area, expanded.

(d) Draw an arc, R2, from point C, using point B as its center. Connect this arc to the final segment secondary area boundary with a connecting line 30§ relative to the final approach course tangent to the arc. This area is now part of the secondary expanded.

(3) Obstacle Evaluation. The arcs, R1 and R2, create expansions of the primary and secondary areas, respectively.

(a) The area created by R1, and its connecting line, is considered final segment primary area, and primary are ROC applies.

(b) The area created by R2, and its connecting line, is considered final segment secondary area, and secondary area ROC applies.

(c) The obstacle surface in the secondary area rises from the edge of the primary area, perpendicular to the final approach course, extended backwards, as necessary, to accommodate that portion of the secondary located prior to the plotted position of the FAWP. Obstacles located in the small secondary area wedged between the intermediate segment secondary boundary through point A, and the final segment secondary boundary which rises from point A, perpendicular to the final approach course, are measured to point A.

(4) Minimum Length of the Final Approach Segment. This length is based on the turn angle at the FAWP. See appendix 1, table 2, for turns that exceed 15§. *

SECTION 4. MISSED APPROACH

14. MISSED APPROACH SEGMENT. The missed approach segment begins at the MAWP and ends at a point designated by the clearance limit. These criteria consider two methods of designing missed approaches. They are identified as "Route" or "Direct."

a. Route. Positive course guidance provided by GPS is required throughout the missed approach segment. The length of the segment is measured point-to-point between the respective plotted positions of the waypoints throughout the missed approach procedure.

(1) A WP is required at the MAP and at the end of the missed approach procedure.

(2) A straight, turning, or combination straight and turning missed approach procedure may be developed.

(3) Turns should be the minimum required for the procedure and shall not exceed 120° in any case.

(4) A minimum segment length is required to allow the aircraft to stabilize on course immediately after the MAP. See appendix 1, table 4, for minimum distances required for each category of aircraft based on course changes.

(5) For the combination straight and turning missed approach, the distance between the latest point the MAWP displacement area and the earliest point the turn WP displacement area shall be sufficient to contain the length of turn anticipation distance required. This segment shall be aligned within 15° or less of the extended final approach course.

b. Direct. A direct missed approach may be developed to provide a method to allow the pilot to proceed to a waypoint that is not connected to the MAWP by a specified course. Positive course guidance is not assumed during the entire missed approach procedure.

(1) A WP is required at the MAP and at the end of the missed approach procedure.

(2) A straight, turning, or combination straight and turning missed approach may be developed.

(3) The combination straight and turning missed approach procedure shall include a climb from the MAP to a specified altitude. The end of the straight section shall be established by an altitude, and the segment shall be aligned with the final approach course. The length of the straight section shall be determined by subtracting the lowest

* Figure 6a, IWP is also the IAWP, paragraph 12b(2)(c)1

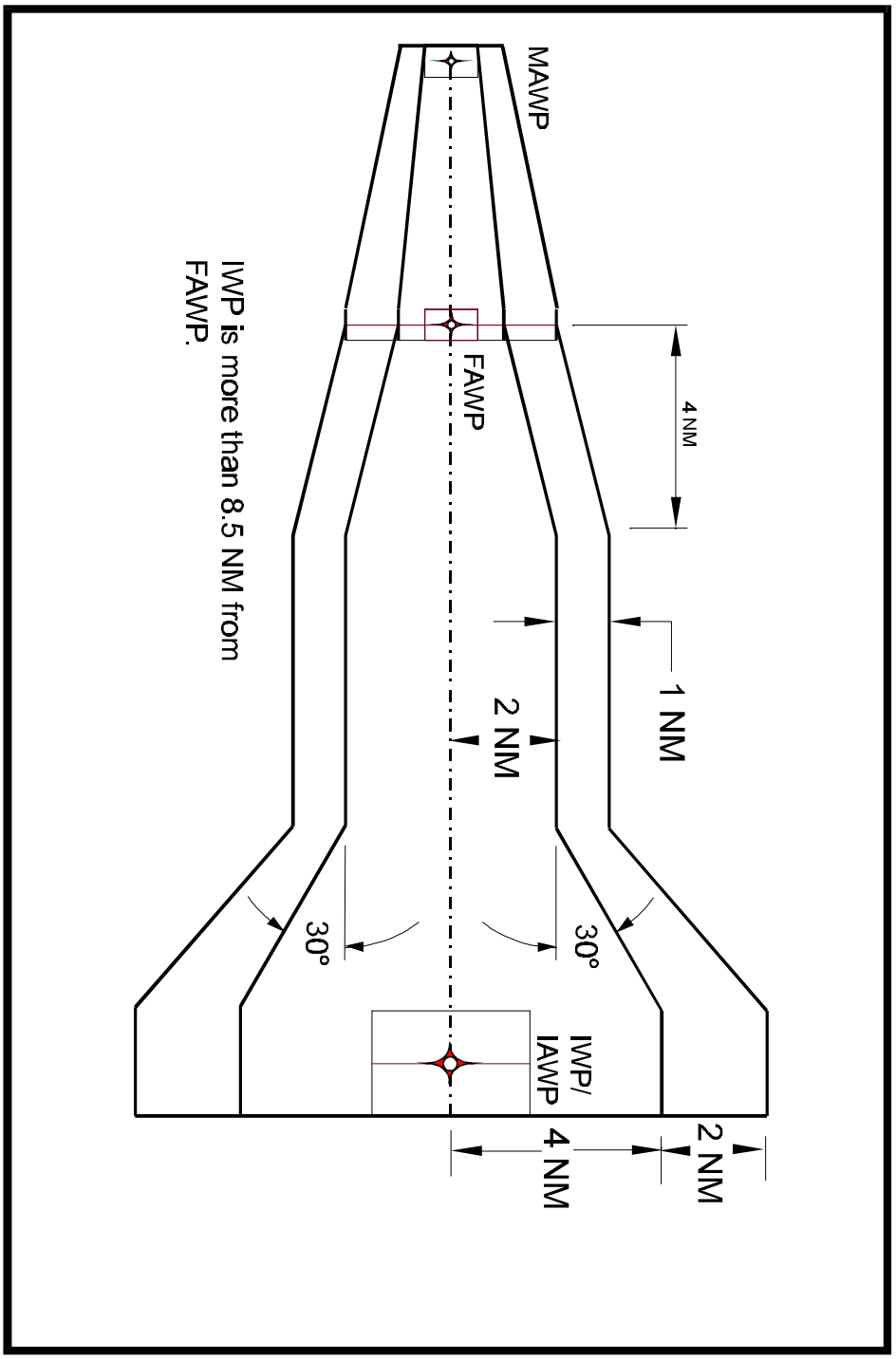


Figure 6b, IWP is also IAWP, Paragraph 12b(2)(c)2

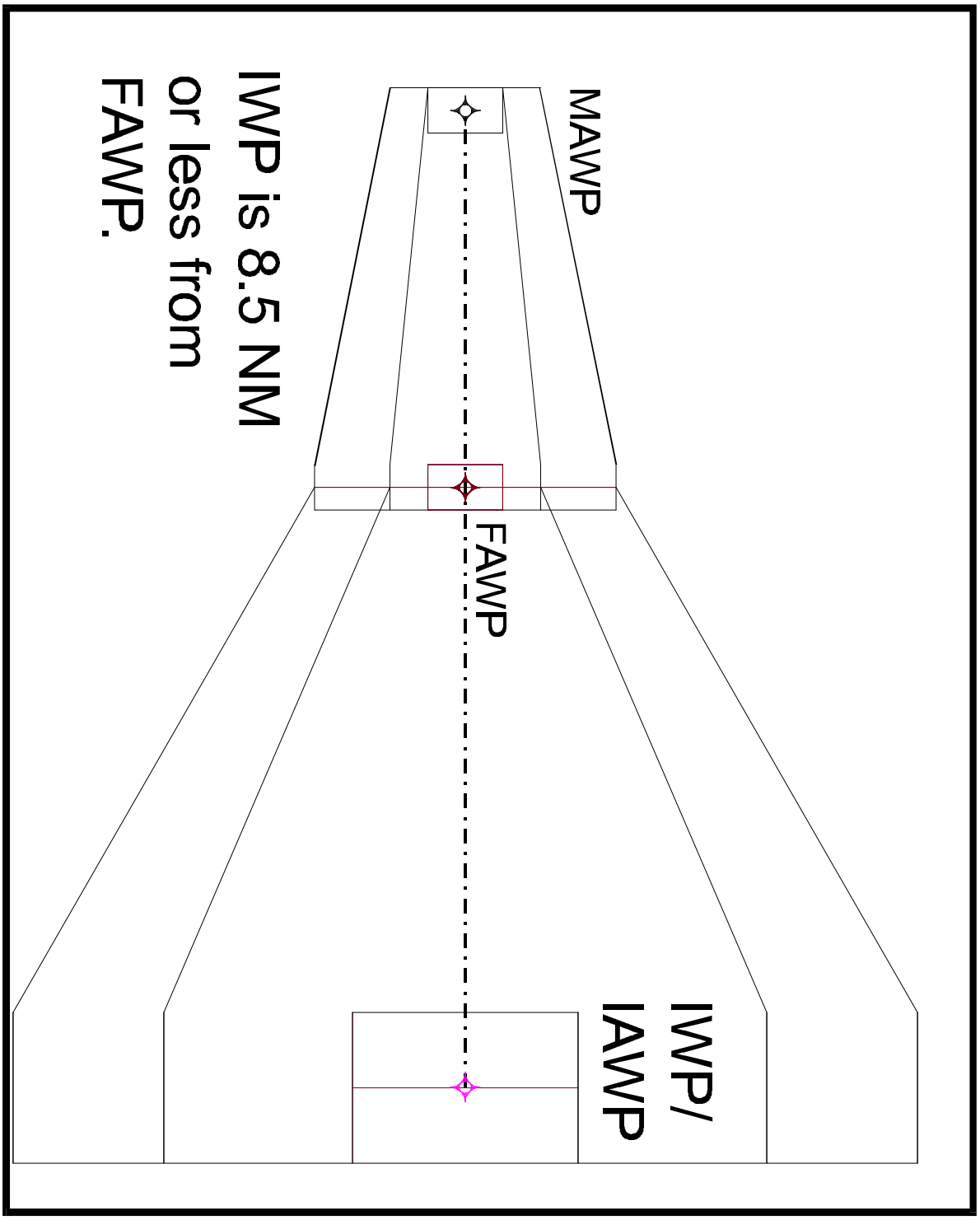
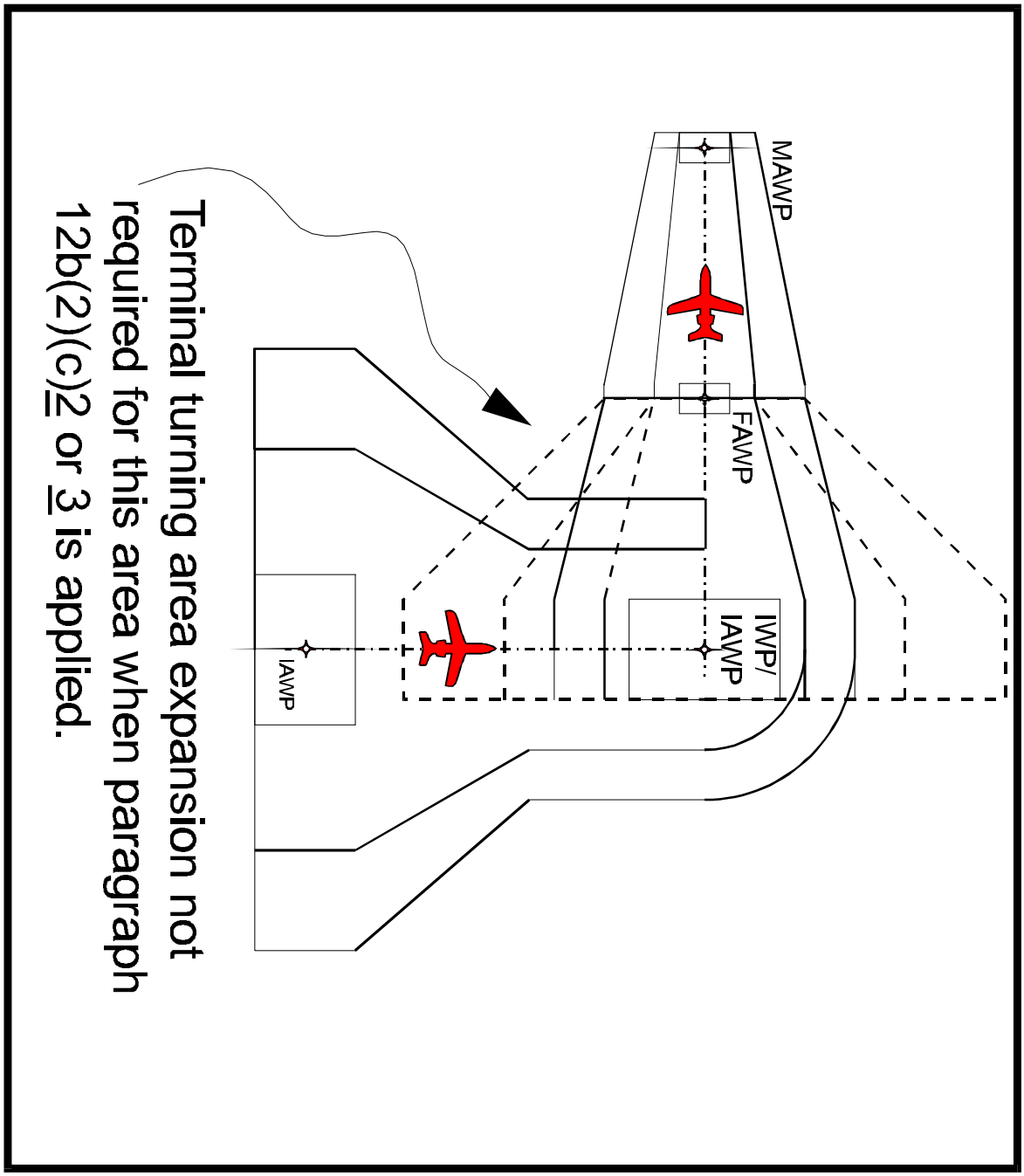


*Figure 6c, IWP is also IAWP, Paragraph 12b(2)(c)3



* Figure 10A. FAWP Turn Expansion Construction.

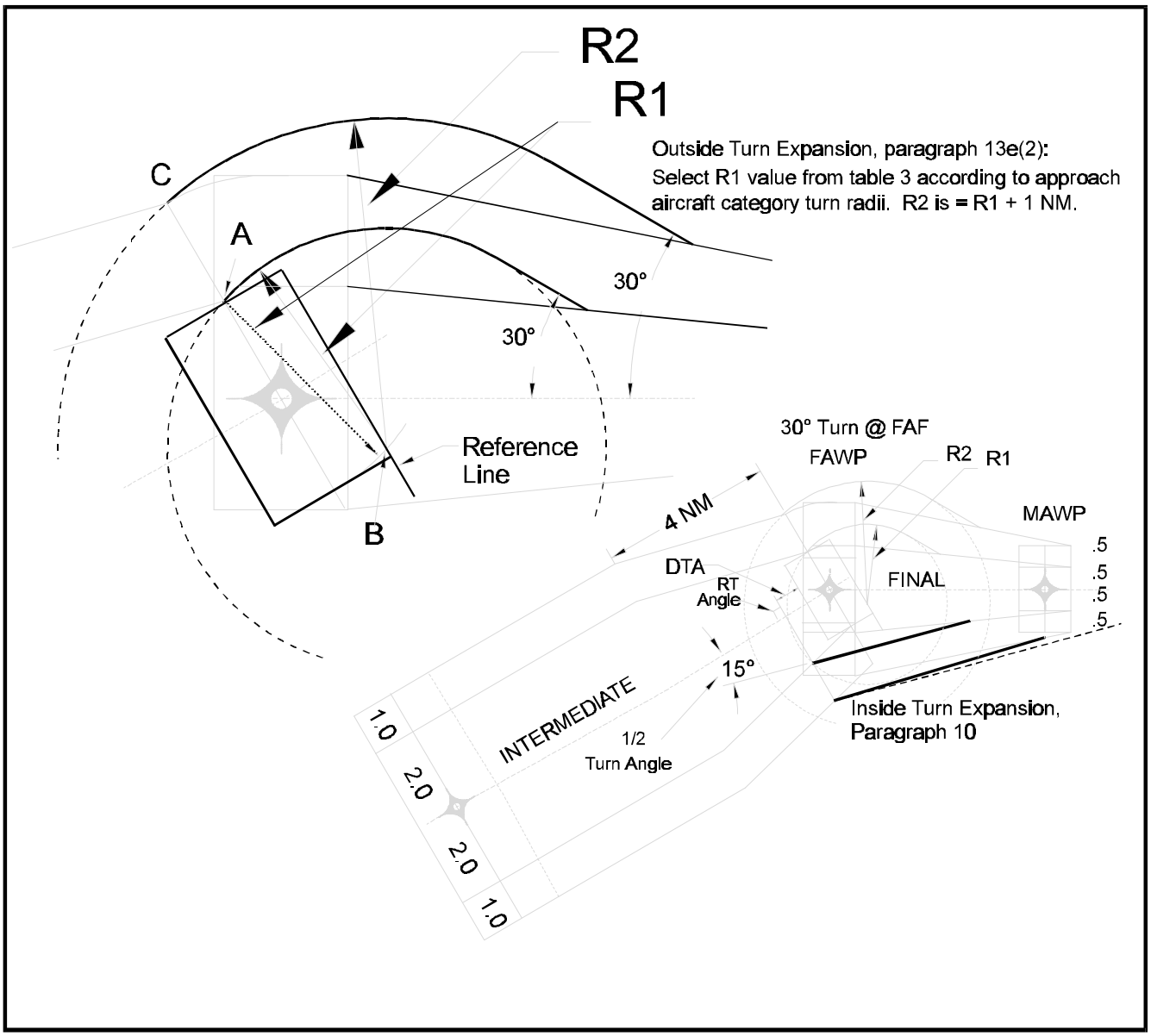


TABLE 1

GPS FIX DISPLACEMENT TOLERANCE

	EN ROUTE	***TERMINAL***	***APPROACH***
XTRK	**2.8**	**1.5**	**0.5**
ATRK	**2.0**	**1.0**	**0.3**

Table Application Per Segment of Table 1

	En Route	***Terminal***	***Approach***
Segment:			
En Route	**X**		
Feeder	**X**		
Feeder Stepdown	**X**		
IAWP and Initial Stepdown	**X (More than 30 NM from ARP)**	**X (At or Less than 30 NM from ARP)**	
IWP		**X**	
Intermediate Stepdown		**X**	
FAWP			**X**
Final Stepdown			**X**
MAWP			**X**
Missed Approach Turn Point		**X**	
Missed Approach Holding		**X**	

TABLE 2

MINIMUM LENGTH OF FINAL APPROACH SEGMENT

MAGNITUDE OF TURN OVER THE FINAL APPROACH WAYPOINT (FAWP)			
	0° – 5°	> 5° – 10°	> 10° – 15°
APPROACH CATEGORY			
A	1.8	1.8	2.0
B	1.8	2.0	2.5
C	2.0	2.5	3.0
D	2.5	3.0	3.5
E	3.0	3.5	4.0

MAGNITUDE OF TURN OVER THE FINAL APPROACH WAYPOINT (FAWP)			
	>15° – 20°	> 20° – 25°	> 25° – 30°
APPROACH CATEGORY			
A	2.2	2.3	2.4
B	2.8	2.9	3.0
C	3.2	3.3	3.5
D	3.7	3.9	4.1
E	4.4	4.6	4.9

TABLE 3

OUTSIDE TURN EXPANSION RADII

APPROACH CATEGORY	R1 (Primary Area Radius)
	NM
A	1.7
B	2.0
C	2.2
D	2.5
E	2.9

TABLE 4

MINIMUM LEG LENGTH FROM MAWP TO NEXT WP USING GPS MISSED APPROACH PROCEDURES
(For Route Missed Approach)

Course Change at MAWP					
CAT	>15° ≤30°	≤ 45°	≤ 60°	≤ 90°	≤ 120°
Minimum Leg Length, NM, Between MAWP and Next WP					
A	3.0	4.0	5.0	5.9	6.9
B	3.0	4.0	5.2	6.2	7.2
C	3.0	4.2	5.5	6.5	7.6
D	3.0	4.5	6.0	7.3	8.5
E	3.0	5.5	7.8	9.5	11.3